PHYSICS CLUB
STEM ASYUT

Grade 10

PHYSICS LO.10

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Study guide

1-Measuring Temperature
2-Temperature scale
3- Heat capacity
4- Specific heat capacity
Serway:10.2,11.1,11.2
https://www.youtube.com/watch?v=6qiYcyhI158&t=1s
https://youtu.be/IoHXMaiwT80?si=GcbnYktI1wmNJhYX
https://youtu.be/QlusUNM1ehA?si=k72diSCkOKCoMoRg
https://youtu.be/GNelfJ6IAJw?si=MoHSmcm9IQc7rpJb
https://youtu.be/ePm_N6RgLfk?si=I-QoCxS6NbL0a5ZQ

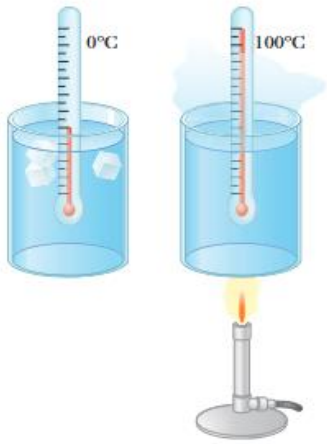
Temperature

Temperature is a physical quantity that quantitatively expresses the attribute of hotness or coldness. Temperature is measured with a thermometer. It reflects the average kinetic energy of the vibrating and colliding atoms making up a substance. Thermal vibration of a segment of protein's alpha helix.

Measuring Temperature and Temperature scale

Thermometers are devices used to measure the temperature of an object or a system.

An example of such a scale is the Celsius temperature scale,
formerly called the centigrade scale. On the Celsius scale, the temperature of the ice–water mixture is defined to be zero degrees Celsius, written 0°C and called the ice point or freezing point of water. The temperature of the water–steam mixture
is defined as 100°C, called the steam point or boiling point of water. Once the
ends of the liquid column in the thermometer have been marked at these two
points, the distance between marks is divided into 100 equal segments, each corresponding to a change in temperature of one degree Celsius.



If we want to measure the temperature of a substance,
we place the gas flask in thermal contact with the substance and adjust the column
of mercury until the level in column A returns to zero. The height of the mercury column tells us the pressure of the gas, and we could then find the temperature of the substance from the calibration curve.

Thermometer

Liquid Thermometer

Mercury or alcohol

Change length of liquid by temperature

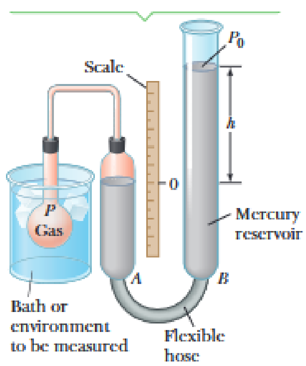
$t = 100 \times \{(Lt - Lo)\} \div \{(L100 - Lo)\}$

Gas Thermometer

Constant volume

Change of pressure of gas by
temp

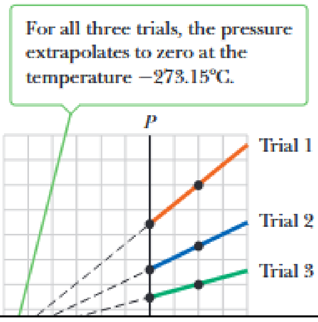
$t = 100 \times \{(Pt - Pt)\} \div \{(P100 - Po)$



Platinum Thermometer

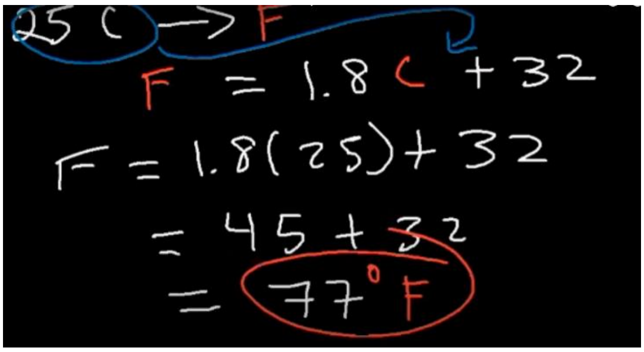
Platinum wire
Change of resistance of wire by temperature
t= 100×{(Rt - R)}÷{(R100 - Ro)}

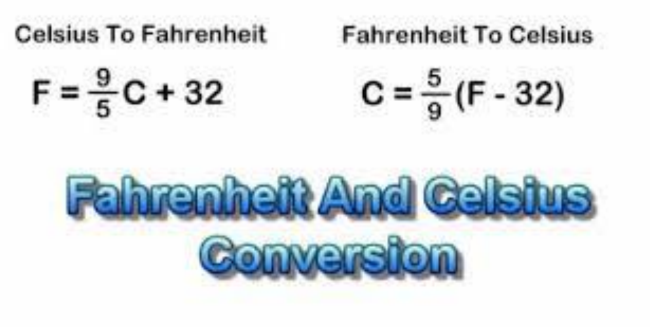
In every case, regardless of the type of gas or the value of the low starting pressure, the pressure extrapolates to zero when the temperature is -273.15°C.
Absolute zero is used as the basis for the Kelvin temperature scale, which sets -273.15°C as its zero point (0 K).



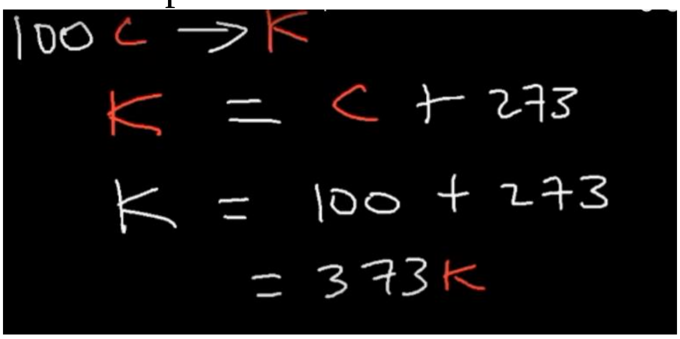
Pressure versu temperature for experimental trials in which gases have different pressures in a constant-volume gas thermometer

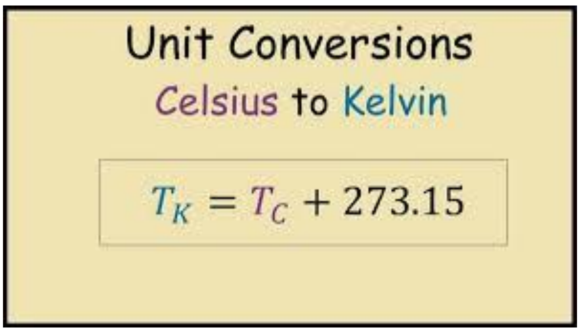
1-To convert from Fahrenheit to Celsius
For example:



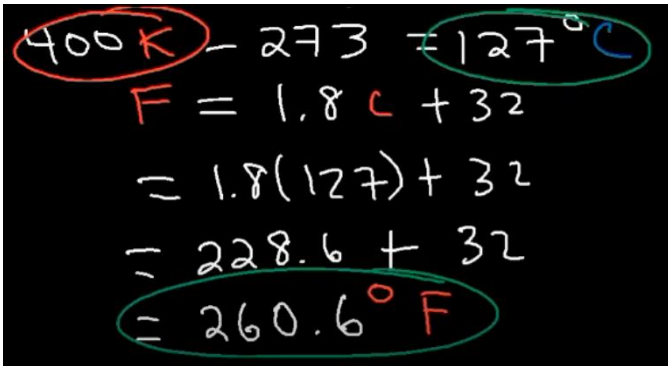


2-to convert from Celsius to kelvin
For example:





To convert from kelvin to Fahrenheit



Temperature scale

Scale	Ice point	Steam point
Fahrenheit	32°F	212°F
Celsius	0°C	100°C
Kelvin (absolute)	273.15 K	373.15 K

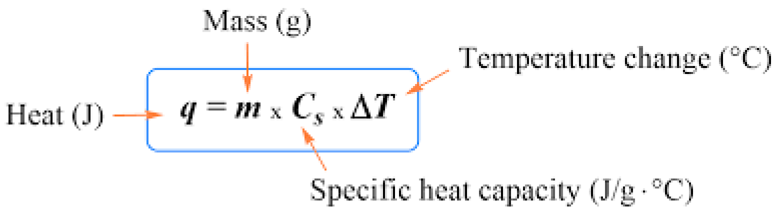
Heat capacity

Amount of heat necessary to raise the temperature of the object by 1c

C= ***Q***÷T

It is expressed in units of thermal energy per degree temperature.

the **specific heat capacity** (symbol *c*) of a substance is the amount of heat that must be added to one unit of mass of the substance in order to cause an increase of one unit in temperature.



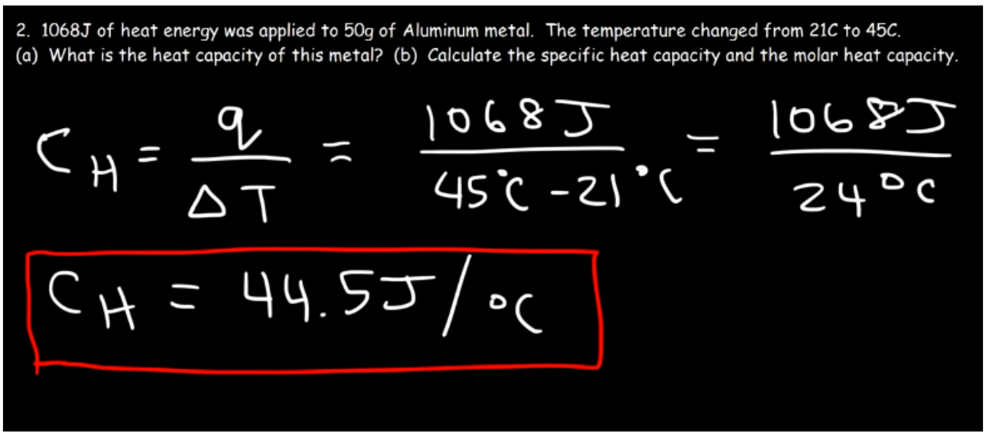
If a quantity of energy Q is transferred to a substance of mass m, changing its temperature by $\Delta T = T_f - T_i$, the **specific heat** c of the substance is defined by

$$c \equiv \frac{Q}{m \Delta T} \quad [11.2]$$

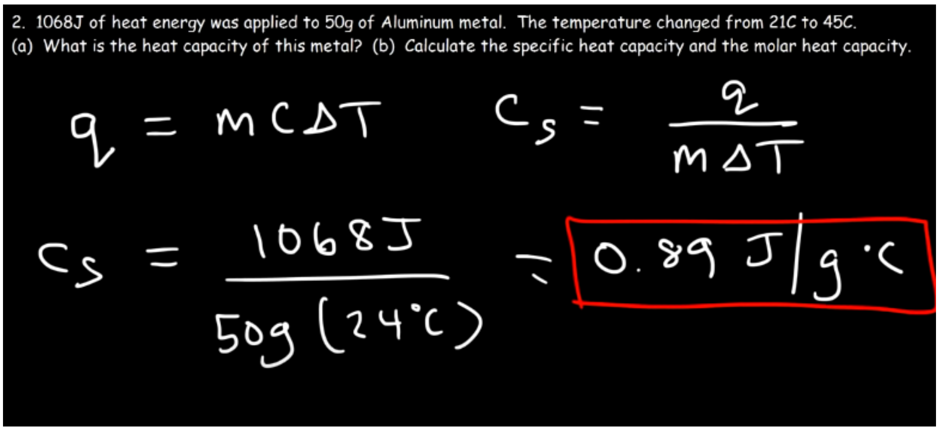
SI unit: Joule per kilogram-degree Celsius (J/kg · °C)

It is expressed in joules per gram per degree Celsius Because, the specific heat of lead is 0.128 , 0.128 Joules of heat is required to raise one gram of lead by one 1°C.

HEAT CAPACITY



SPECIFIC HEAT CAPACITY



Molar Heat Capacity

➢ The amount of heat needed to increase the temperature of one mole of a substance by one degree.

➢ It is expressed in joules per moles per degrees Celsius (or Kelvin) (J/mol .oC)

➢ For example, the molar heat capacity of lead is 26.65 , which means that it takes 26.65 Joules of heat to raise 1 mole of lead by °C.

Thermal energy

-Thermal energy is the kinetic energy of all molecules of a system added together, and it results from the motion of atoms and molecules within substance and is directly related to temperature.

-For example: The greater the movement of particles, the higher the thermal energy

Heat:

-Firstly, what is heat?

-Heat is the flow of the thermal energy or the amount of thermal energy added to or moved from the system.

-Also, it is the transfer of energy between a system and its environment due to the temperature difference between them.

Thermodynamics:

Thermodynamics is a whole branch of physics dealing with how heat is transferred between 2 different systems and how work is done in the process.

Units of heat:

joule (because heat is a form of energy)

Calorie

BTU (British Thermal unit) the English u it of heat BTU.

Units of heat:

- 1Cal=4.19j
- 1BTU=252cal
- 1therm=252*10^5cal

- Ex:56BTU=252*56=14.112*10^3cal

Heat conduction:

- The movement of heat from one object to another one that has different temperature when they are touching eachother.
- There are 2 types of materials:
- Conductors: high thermal conductivity (iron)
- Insulators: low thermal conductivity (wood)

The molecules in the warmer object vibrate faster than ones in the cooler one.

Convection:

Convection is the rising motion of warmer areas of a liquid or gas, and the sinking motion of cooler areas of liquid or gas, sometimes completing cycle

Radiation:

- Radiation is the heat that is transferred by electromagnetic waves.
- Thermal waves: the emission of electromagnetic waves from all matter that has a temperature greater than absolute 0.

Blackbody radiation:

Blackbody radiation is a term used to describe the relationship between an object's temperature, and the wavelength of electromagnetic radiation it emits. A black body is an idealized object that absorbs all electromagnetic radiation it comes inContact with.

-A star is a near-perfect blackbody.

-The white-hot filament of a bulb is a good blackbody because all light from the filament is thermal radiation and almost none of it is reflected from other sources.

Solar heat collector:

- It is a device for capturing radiation
- The quantity of solar energy striking earth is about 1000 watts per square meter under clear skies
- Solar water heating systems have 2 parts

1- Collector: to capture the radiation in water

2- Storage tank: to store and insulate the hot water

Natural sources of heat: sun, geothermal:

- 1- Solar
- Heat arrives from the sun as electromagnetic radiation
- It varies depending on the time of day and season, but it is enough to support light
- Fun fact: the sun is the main source of energy for life on earth
- 2- Geothermal
- It comes from the hot core of the earth through conduction

- The core of the earth is hotter than the surface of the sun
- Over a very long time, all geothermal energy on the earth will be depleted
- Geothermal energy can be utilized by hot springs and underground water to heat homes.

Latent heat

- Is the energy (Q) required for a substance to finish changing phases
- L = Q/m

Where:

• L = Latent heat

• Q = amount of heat absorbed/emitted

• m = unit mass of a substance or mole amount of a substance

Specific latent heat

1. Latent heat of fusion
    - • It describes the change between solid and liquid phases by
    - melting a solid or freezing a liquid
2. Latent heat of vaporization
    - • It describes the difference between gas and liquid phases by
    - vaporizing a liquid or condensing a vapor
3. Latent heat of sublimation

• It describes the difference between solid and gas phases by

- subliming a solid or depositing a gas.

Latent heat helps understand the water phase change diagram

• phase B

- • When ice melts, it remains at 0 degrees until it is all liquid water, because
- the heat energy will be absorbed into the latent heat of fusion Phase D
- When water keeps boiling, the temperature of the liquid will stop at 100 degrees and continue like that until the last drop of water is evaporated because the heat energy is being absorbed into the latent heat of vaporization

Material	Heat of fusion L_f (J/kg)	Heat of vaporization L_v (J/kg)
copper	2.05×10^5	5.07×10^6
mercury	1.15×10^4	2.72×10^5
gold	6.30×10^4	1.64×10^6
methanol	1.09×10^5	8.78×10^5
iron	2.66×10^5	6.29×10^6
silver	1.04×10^5	2.36×10^6